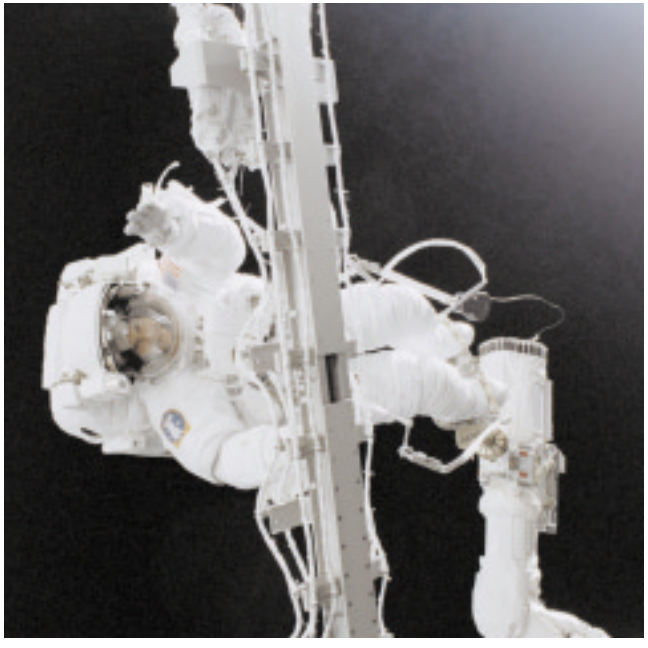
National Aeronautics and
Space Administration

Tools for Spacewalking



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Over the next few years, astronauts will spend more than 30 days building the International Space Station (ISS) through a series of spacewalks, known as Extravehicular Activities, or EVAs. The amount of spacewalking time required will more than double the total number of EVA hours undertaken in the nearly 40 years before the ISS assembly began.

To ensure success, it is important to have the proper tools and devices to assist spacewalking astronauts.

Simplified Aid For Extravehicular Activity Rescue (SAFER)

SAFER, is a small, self-contained, propulsive backpack device that can provide free-flying mobility for a spacewalker. This jetpack's primary purpose is to safely return the spacewalker to the ISS if he or she accidentally becomes untethered. Attached to the spacesuit's display and control module is a hand controller, similar to a joystick, which operates various combinations of thrusters to propel the astronaut back to the safety of the ISS. Each of the 24 fixed-position thrusters expels nitrogen gas with a force of 3.6 newtons (less than one pound of force). The astronaut can move the SAFER up and down, back and forth, and side to side, and yaw, pitch, and roll by manipulating the hand controller.

The nitrogen is contained in highly pressurized tanks that cannot be recharged in orbit. If the SAFER is used, a Space Shuttle must bring a new unit to the ISS. Used units will be brought back to Earth and recharged for future use. Three SAFER units will be stored aboard the ISS.

The Space Shuttle Remote Manipulator System (RMS) Robot Arm

The robot arm, also called the Canadarm because it was designed and built in Canada, has added to the success of numerous spacewalks. The 15-meter-long arm is mounted near the forward end of the port side of the orbiter's payload bay. It has six degrees of freedom, allowing it to move much like a human arm. Astronauts use the Canadarm to move large objects around the ISS and to position fellow crewmembers during spacewalks. During operations, an astronaut inside the orbiter controls the robot arm.

Mobile Servicing System (MSS)

The ISS Mobile Servicing System is an essential component in space station assembly and maintenance. Some of its primary functions are

- Assisting in ISS assembly by aligning newly delivered modules to the existing structure;
- Supporting astronauts during extravehicular activities;
- Assisting in ISS maintenance;
- Providing transportation around the ISS.

The system consists of the Space Station Remote Manipulator System (much like the Space Shuttle's Canadarm), the Servicer Base System, the Special Purpose Dexterous Manipulator, and the Mobile Transporter. The key component is the 17-meter-long Remote Manipulator System, known as the Canadarm2 because it also was designed and manufactured in Canada. The Canadarm2 will ride from one end of the ISS to the other on the Mobile Transporter, which will glide along the giant truss beam. After arriving at the work site, the arm will grasp payloads, modules, or other structures with its wire snare end effector, or hand.

Tethers

Tethers, similar to ropes, ensure that tools and astronauts do not float away. Spacewalkers link themselves to their spacecraft using long, retractable safety tethers. One end is attached to the spacesuit, while the other is attached to a slide wire or handrail. This allows the spacewalking astronauts to stay attached while permitting them to move quickly and safely around the station or shuttle to perform the assigned tasks. Tethers require two separate actions to open, ensuring they don't accidentally become unlatched. Tools are tethered to the spacewalking astronaut to ensure no tools are lost. They are hard to retrieve if they get loose.

Photos on Front

Top right: Astronauts Jerry L. Ross (left) and James H. Newman work together during the STS-88 mission. One of the solar panels of the Russian-built Zarya module runs through the frame. *Bottom right:* Astronaut Susan J. Helms works while holding onto a rigid umbilical. Her feet are anchored to the remote manipulator system (RMS) robot arm on the Space Shuttle Discovery. *Left:* Astronaut Thomas D. Jones performs work on the International Space Station (ISS).

Electronic Resources

For more information about spacewalking, please visit our website at **http://spaceflight.nasa.gov**, or download the "Suited for Spacewalking" educator guide at **http://spacelink.nasa.gov/products/Suited.For.Spacewalking**.

Please take a moment to evaluate this product at **http://ehb2.gsfc.nasa.gov/edcats/lithograph**
Your evaluation and suggestions are vital to continually improving NASA educational materials. Thank You.

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